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Gender Preferences in Web Design:
Usability Testing through Eye Tracking

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Abstract

A successful website not only contains useful information but also displays this information in a way that is easily recognized by its users. One way to accomplish this is by investigating users' visual preferences when using a web page. While each user may have unique tastes, they all can be organized into demographic groups with associated visual penchants. For example, literature provides evidence that there is a difference in layout preference between men and women. Using this literature, in this study, we examine whether such gender preferences can influence the recognition of specific information provided by specific items on a web page. To test our hypothesis we conduct a laboratory experiment. In addition to collecting subjective data, as in most prior studies, we also use an eye tracker that collects information regarding users' fixation. The results of this study as well as their implications are discussed.

Keywords

Gender Preferences, HCI, Eye Tracker, Fixation, Usability, Web Design

Introduction

Human Computer Interaction (HCI) is important for the proper development of websites. For example, the analysis of user preferences can help to optimize the usability of websites. One way to achieve this is by examining users' preferences and examining factors that may influence such preferences. For example, there is evidence that men and women exhibit different preference in layout and presentation of stimuli (Moss et al. 2006). In this study, we examine possible gender differences in web preference via a laboratory experiment. In addition to self report instruments, we also use an eye tracker to collect information regarding users' fixation. Although eye trackers have also been employed in few older studies (e.g., Richardson and Spivey 2004), these studies did not examine whether men and women had different preferences when viewing information on a website. Moreover, due to technological limitations, the data collected through eye tracker in these studies were limited. For example, these older studies required users to wear special devices (e.g., head gears) to track their eye movements. Such a requirement not only limits users' head and eye movement but also creates an unnatural setting. Moreover, these devices were not sensitive enough to detect eye movement of users who wore eyeglasses or contact lenses (Richardson and Spivey 2004). The eye tracker used in our study does not pose any of these limitations. That is, users' eye movement is tracked unobtrusively through a camera mounted on the monitor they use.

In the following sections, first the theoretical foundation on gender theories is reviewed. Then, some relevant hypotheses are formed. Finally, an experiment is conducted to test our hypotheses.

Theoretical Foundation

During recent years, companies have put a significant amount of resources into creating and improving websites that benefit internal (e.g., employees) and external (e.g., customers) users (Goodwin 2006, Hammer 1995). With a website that is highly functional and visually pleasing for users, the overall experience with the company is elevated (Goodwin 2006). Improvement of the website will enable the company to better target and inform users of beneficial opportunities and advice that they can use towards their advantage. In addition to saving cost, having easy online access to all of the company's services and information about those services makes utilizing the capabilities of the company more convenient, which in turn can increase the value of the company. Therefore, by accommodating their users, companies can potentially benefit financially from having successful websites.

In order to enhance a user's experience online, several companies now offer bricklets on their websites. A bricklet is a small window with specific useful information that makes the navigation faster and easier for a user (e.g., important notices and/or links to frequently visited website). The main purpose of bricklets is to bring important information to the attention of a user. While many factors can influence the effectiveness of bricklets, in this study we focus on the effects of background color and image and investigate whether these factors can affect the noticeability of bricklets by male and female users.

Theories and Hypotheses

Literature suggests that visual attractiveness of a website can influence whether the site is perceived as useful, enjoyable, and easy to use (Van der Heijden 2003). Judgments regarding attractiveness of a website, according to the interactionist paradigm of aesthetics (Porteous, 1996), are formed through an interaction between the website and the user (Moss et al. 2006). In other words, attractiveness not only depends on the characteristics of the stimuli but also on how those characteristics are perceived by a viewer. Since literature provides ample evidence that men and women exhibit differences in what they perceive as attractive (e.g., Moss and Colman 2006), grounded in the interactionist paradigm of aesthetics, many studies have attempted to examine the differences in the aesthetic values of men and women (e.g., Moss et al. 2006; Tedesco et al. 2004).

Socio-biological research suggests that men and women are not only different due to socialization (gender roles) but also due to inherent factors (Lueptow et al. 1995). A number of studies show that men and women process signals received from stimuli differently (Kimura 1992; Gregory 1998). Studies also show that men and women differ in their aesthetical choices and preferences (e.g., Moss and Colman 2006; Moss et al. 2006; Tedesco et al. 2004). For example, women tend to choose greeting cards that are designed by women more than cards that are designed by men and vice versa (Moss and Colman 2006). When designing websites, men and women tend to show different preferences in how they create their web pages in several factors (Moss et al. 2006; Tedesco et al. 2004). For example, men prefer to use darker colors such as black and blue while women prefer lighter colors. Women, more than men include images in their web design (Moss et al. 2006). A study conducted at Fidelity Investments Usability Labs (Tedesco et al. 2004) shows when participants are asked to choose from 105 individual content pieces to build their ideal website, men and women include different types of objects in their design. In particular, women, more than men, chose images of people to include in their websites (Tedesco et al. 2004).

Such differences in preference between men and women are argued to be related to innate factors. It is suggested that male superiority in visuo-spatial imagery (Kimura 1992) may be the underlying reason for their preferences for 3-D design and female superiority in color vision (Gregory 1998) maybe the cause of gender difference in color preferences (Moss and Colman 2006).

Using the above literature we predict that there will be a difference in noticeability of the bricklets used in this study between the male end female users. Men and women respond more favorably to products designed by the member of their own gender, who tend to show different preferences in terms of images and colors when designing a websites (Moss and Colman 2006, Moss et al. 2006; Tedesco et al. 2004). Hence, it is likely that men and women in our study respond differently to bricklets that have light and dark background colors and those that contain images of people.

> H1) Female participants will notice bricklets with pictures of people more than males.

> H2) Female participants will notice bricklets with a light color background more than males.

Methodology

In this section we provide a brief overview for the material used in the study. We also explain how this experiment was designed and conducted.

Participants and Design

This study was conducted at Fidelity Investments Usability Labs. The participants were 17 male and 19 female employees at Fidelity Investments. The ages of the participants ranged from 20 to 60. None of the participants has seen the bricklets that were used in this study. Since the task used in our study involved contributions to one's retirement, these employees provided a suitable pool of subjects. To eliminate possible confounding effects of knowledge about retirement accounts, through a screening process (a financial literacy survey) we recruited only the participants that had an average knowledge about retirement accounts. We also eliminated possible confounding order effects by presenting the task and the bricklets to participants in different orders.

Procedure

Upon arrival, the participants were informed that in order to record their fixation we needed to calibrate the eye tracker to their eyes. To do so we asked the participants to follow the eye tracker's calibration process, which requires the participant to visually follow a blue dot across the computer screen, which allowed us to adjust the eye tracker for each individual user. After this calibration (which lasted approximately 10 seconds) was completed, the participant started the tasks that were designed for the experiment. After completing the tasks, each participant completed a self report survey that collected information regarding the noticeability and visual appeal of the bricklets.

Tasks

The tasks in this study were not designed to test the participants' knowledge or skills, but rather how the bricklet design helped them complete the tasks. Participants were required to navigate the website to find certain information such as the total amount of investments in several different plans and accounts. In addition, the participants were required to perform a transaction that maximized the company match for contribution in a 401(k) account within a particular savings plan. Of the tasks, only one could have been done with the use of the bricklet. Participants were able to complete this task without the bricklets; however, using the bricklets would have made completing the task much easier. The other tasks were filler tasks in which using the bricklets was unnecessary, but directed the user to look in all areas of the page around the bricklet. All tasks involved starting on the homepage and the page contents remained the same for each user. The mean of completion time for these tasks did not exceed five minutes.

Bricklets

To test possible discrepancies between gender preferences for bricklets with light and dark background colors and bricklets with or without images of people we used four bricklets with four different designs (see Figure 1). All bricklets contained the same information and differed only in background color and/or whether they contained a picture. As shown in Figure 1, two of these bricklets had the same dark background color (Bricklet A and D); only one of these two bricklets contained a picture. Two other bricklets had the same light background (Bricklet B and C); however, only one of these two bricklets contained a picture. The same picture was used in the bricklets which contained an image (Bricklet C and D).
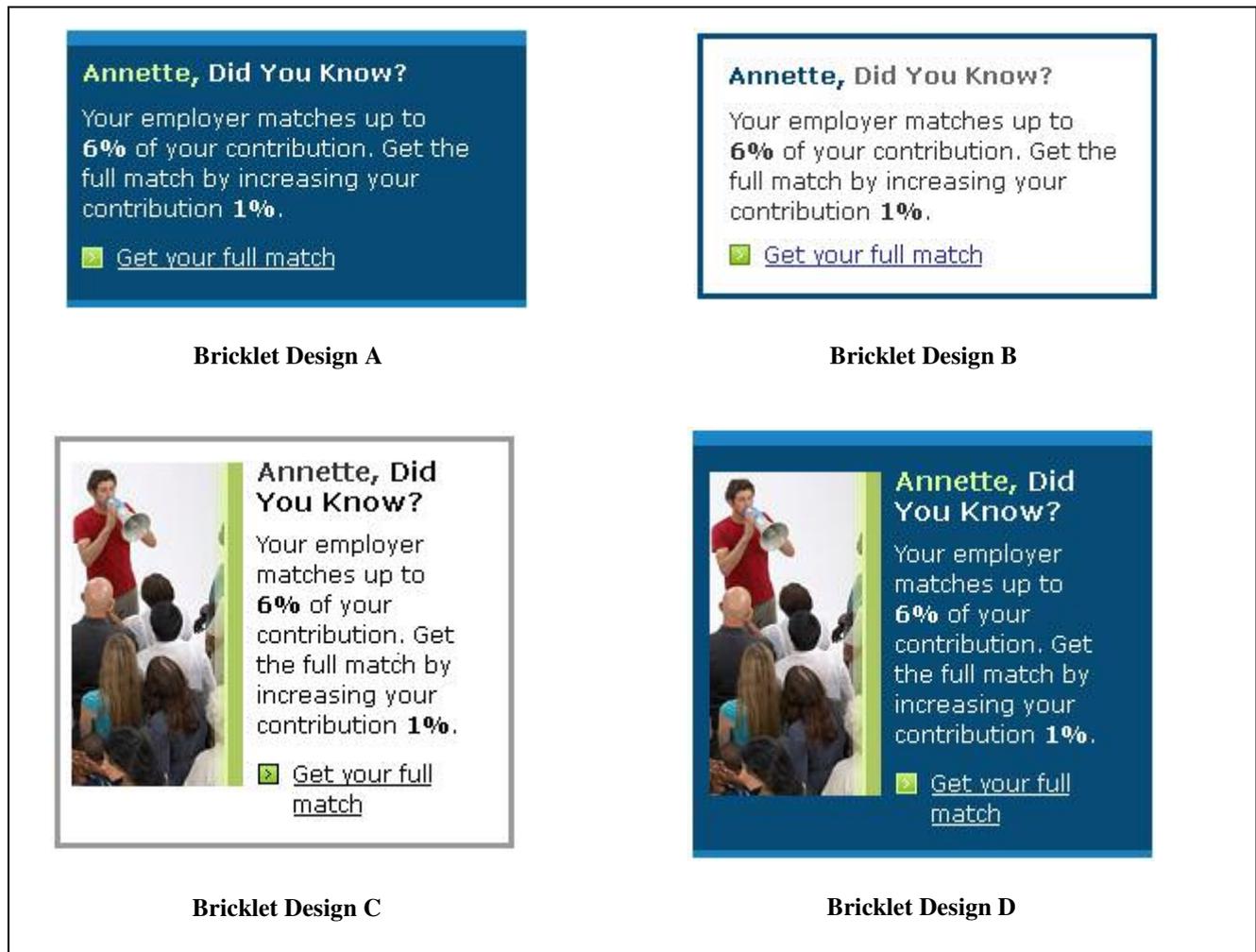
Figure 1: Bricklet Design. Bricklet Design A- dark, no image; Bricklet Design B- light, 2-pixel border; Bricklet Design C- light, side people image; Bricklet Design D- dark, side people image.

Measurements

The eye tracker used in this study was non invasive and users' visual aids, such as glasses and lenses, did not hinder its performance. This eye tracker consisted of four infrared cameras that simultaneously took samples of the eye movements on the monitor. In order for the eye tracker to function properly it was calibrated for each user. This calibration took place at the beginning of each session and lasted approximately 10 seconds.

To measure the noticeability of the bricklets in this study we examined users' fixations, which refer to looking at an object for at least 300 milliseconds. To do so, the eye tracker was programmed to record users' fixations on the page where the bricklets were placed. In other words, we defined for the eye tracker which parts of the web page were the areas which we wished to examine. With this definition, the eye tracker was able to record how many times a user looked at the predefined area (where a bricklet was placed) for a period longer than 300 milliseconds. We also used self report surveys at the end of the sessions. In these surveys, participants were asked to identify all the bricklets that they noticed during the experiment. Moreover, they were asked to rate (on a scale of 1 to 5 where 1=strongly disagree and 5=strongly agree) the visual appeal of each bricklet.

Results

Hypothesis one proposes that female users are more likely than men to notice bricklets that have images of people. Contrary to what was hypothesized, our analysis (paired t-test) of the data collected by the eye tracker did not show any significant difference between the number of times the male and female users fixated on the bricklets with or without images. Figure 2

and 3 display the map of these fixations (the visual representation of the data collected by the eye-tracker). There are five levels of color in this map: black, green, yellow, orange, and red with black representing no activity, and red representing the most activity. While the results of the paired t-test were not significant, as the figure shows, both male and female users fixated on the bricklets without picture more often than they fixated on the bricklets with picture.

Females who fixated within the bricklets with a picture

Females who fixated within the bricklets with no picture
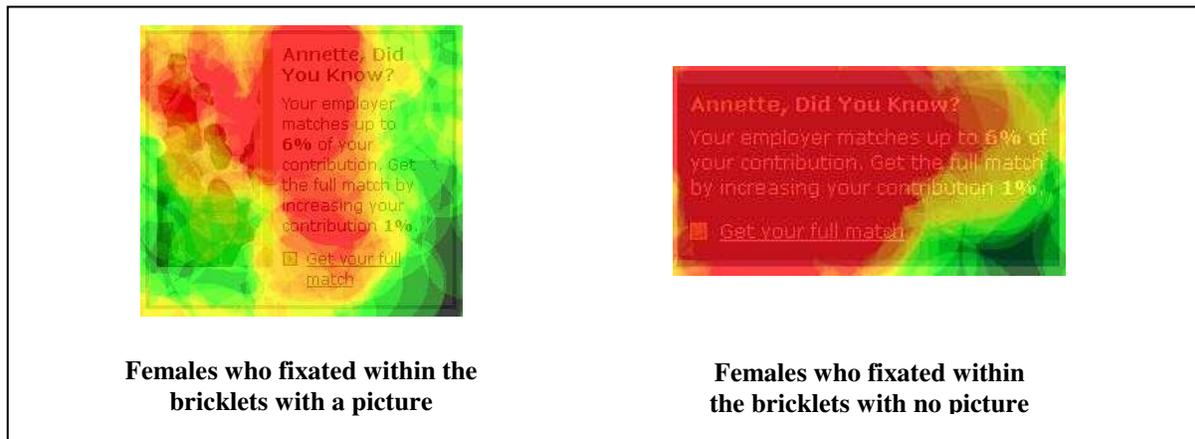
Figure 2: Visual representation of the percentage of females who fixated within the bricklets with and without picture

Males who fixated within the bricklets with picture

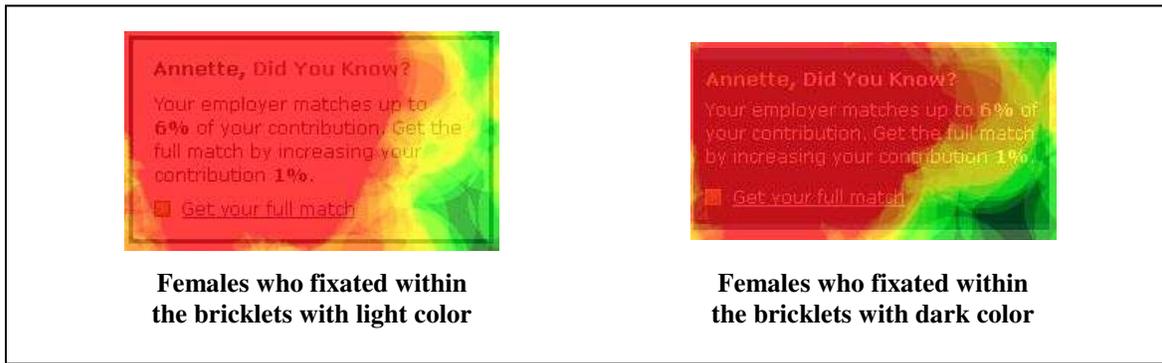**Males who fixated within the bricklets with no picture**
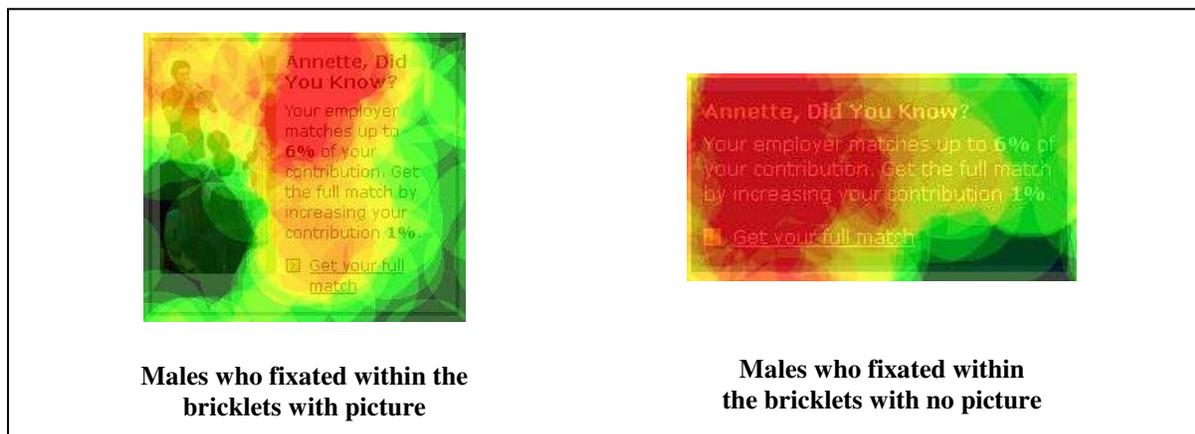
Figure 3: Visual representation of the percentage of males who fixated within the bricklets with and without picture

The analysis of the self report surveys (paired t-tests) showed that the mean of the ratings for visual appeal of the bricklets was significantly higher for the ones with pictures in the male users group (bricklets $_{with\ pictures}$ =3.75, bricklets $_{without\ pictures}$ =3.03, t=3.63, p=0.002). In other words, the analysis of the self report survey showed that male users found the bricklets with pictures significantly more appealing than those without pictures. The paired t-test did not show a significant difference in the visual appeal of the bricklets with or without pictures for women. Similarly, the pair t-tests did not show a significant difference in self reported noticeability of the bricklets with or without pictures for men and women. These results do not support hypothesis one.

Hypothesis two proposes that female users, more than male users, will notice the bricklets with the lighter background color. The paired t-test did not show a significant difference in fixation (stares longer than 300 ms) between male and female users looking at the bricklets with dark and light backgrounds.

Figure 3 and 4 displays the map of fixations or the visual representation of the data for these results. While the results are not significant, they support the direction of the hypothesis, i.e., the mean of fixations is greater for women for bricklets with light colors.

Females who fixated within the bricklets with light color   **Females who fixated within the bricklets with dark color**

Figure 4: Visual representation of the percentage of females who fixated within the bricklets with light and dark color

Males who fixated within the bricklets with light color   **Males who fixated within the bricklets with dark color**
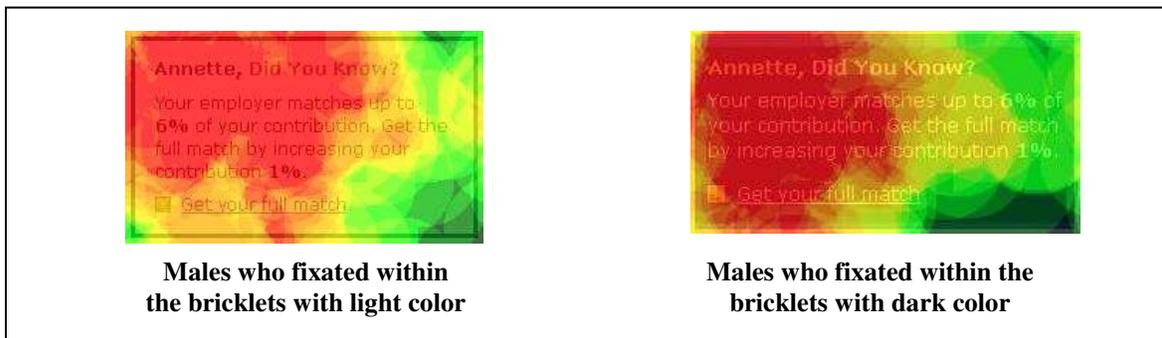
Figure 5: Visual representation of the percentage of females who fixated within the bricklets with light and dark color

The results of the paired t-tests comparing the self reported visual appeal of bricklets with light and dark background showed no significant difference in male and female user groups. However, the paired t-test analysis of survey asking users to identify bricklets that they noticed during the task showed that the mean of identified bricklets was significantly higher for the bricklets with dark background than those with light background in the female user group (bricklets $_{dark\ background}$=1.05, bricklets $_{light\ background}$=0.60, t=2.44, p=0.03). These results show that female users found the bricklets with darker background colors significantly more noticeable. Male users, however, found these bricklets equally noticeable. These results did not support hypothesis two.

Discussion

This study examined the gender preferences of users between bricklets with and without pictures and bricklets with light and dark background colors. The results did not show any significant difference between the genders with regards to the number of times they fixated on the bricklets. Nor did the results of fixation analysis show any significant differences between men and women in regards to bricklets with different background color.

While the results of the fixation analysis did not support our hypotheses, which were based on previous findings regarding image preferences (Tedesco et al. 2004) and color preferences (Moss et al. 2006) of male and female users, these results are aligned with *banner blindness* (Benway and Lane 1998). *Banner blindness* refers to overlooking banners on a webpage (Benway and Lane 1998). There is ample evidence that people overlook banners. Banners on a web page are specifically designed to be notable and clearly distinguishable from other items (Detweiler & Omanson, 1996). Banners often contain useful information that is helpful to users. Nevertheless, users tend to ignore these specially designed items that are designed to capture their attention (Benway and Lane 1998) and therefore miss the very items that would in fact be helpful to them

(Spool et al. 1997). The analysis of fixation in his study, showing no significant difference between male and female users' bricklet preferences, suggests that men and women may equally ignore banner-like objects regardless whether these banner-like objects are designed with their preferences in mind. These results suggest that to provide information companies may benefit from designs other than the ones associated with banners. Future research, however, is needed to clarify whether the type of picture used in the bricklet, the placement of the bricklet, and/or bricklets with different background colors and contrasts can affect the results obtained in this study. Future research is also needed to refine our results by examining whether the type of task and or user population can affect these results.

The analysis of self report survey showed that while male users found the bricklets with pictures significantly more appealing than those without the pictures, they did not find these bricklets to be significantly more noticeable. Women reported to find the bricklets with dark background color significantly more noticeable but not significantly more appealing. These results suggests that 1) visual appeal may not be as correlated with noticeability as it is believed to be and that 2) men an women differ in what they find noticeable and/or appealing. Future research is needed to refine not only our understanding of the relationship between visual appeal and noticeability but also the role that gender may play in such relationship.

Our results also showed misalignment between the data collected by the self report surveys and the fixations data collected by the eye tracker. For example, the analysis of the self report survey showed that female users found the bricklets with dark background significantly more noticeable. The analysis of fixations, however, showed that female users fixated more (while not significantly so) on bricklets with the light background color. Since fixation implies noticing the bricklet, the evidence provided by the eye tracker does not support the results of the self report survey regarding the noticeability in the female user group.

The above results provide further support for the need to examine gender differences in web usage. They also show the importance of using objective measures, such as the data collected by the eye tracker, in such investigations. While it is reasonable to argue that when one finds an object significantly more appealing or significantly more noticeable then one will fixate on that object more, as our results show, this is not necessarily the case. Future studies are needed to clarify the underlying reason for such discrepancy between the self report and fixation results.

As with any experiment the generalizeability of our results are limited to the setting, population, and the task used. We reduced the threats to generalizeability by using an unobtrusive eye tracker to track fixations in a setting (Fidelity Usability Labs) which is designed to resemble realistic environments. Our subjects were all professionals working in a Fortune 100 company. The task used in our study was regarding one's contribution to retirement plan, hence both relevant and realistic to our participants. Nevertheless, future research using different population and task is needed to extend the generalizeability of these results.

The ability to read can possibly affect the results of fixation, e.g. people with low reading skills may need to look at a bricklet more often before they can understand its message. We did not measure the reading skills of our participants. Since participants were all employees of a Fortune 100 company proficient in financial literacy, we could safely assume that all participants had a similar level of reading competence. However, it is recommended that future studies control for this variable should they use a different population.

Today's consumers "demand products and services designed for their unique and particular needs" (Hammer 1995, p. 21). Gender differences are only one consideration for which a website can be customized for individual users. Since companies rely on banner like designs, such as bricklets, to provide users with useful information, examining factors that increase the visibility and usage of such web items is of great interest to organizations. By showing that what was reported on the survey did not necessarily match the fixation data collected by the eye tracker, this study provides important information for organizations and provides support for the importance of incorporating methods other than self reports in HCI research. The results contribute to HCI literature by suggesting that user visual preference maybe affected by the form of web items such as the banner like form of the bricklets in this study. Moreover, since the results offer support for gender differences in bricklet noticeability and preference, they present motivation for expanding the investigation of gender preferences in web design and usage.

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